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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/025,322	12/18/2001	Naoto Kusumoto	07977/076003/US3130/3134D	8044

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EXAMINER	
MALDONADO, JULIO J	
ART UNIT	**PAPER NUMBER**
2823	

DATE MAILED: 08/25/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/025,322	KUSUMOTO ET AL.	
	Examiner	Art Unit	
	Julio J. Maldonado	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 July 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-26* is/are pending in the application.

4a) Of the above claim(s) *13-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12 and 16-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. The rejection of claims 1-26 as set forth in Office Action mailed on 01/14/2003 is withdrawn in view of applicants' amendments filed on 04/14/2003.

2. A new rejection is included in this Office Action.

3. Claims 1-26 are pending in the present application.

Election/Restrictions

4. Applicant's election without traverse of claims 1-12 and 16-26 in the reply filed on 07/24/2003 is acknowledged.

Claim Objections

5. Claims 22 and 26 are objected to because of the following informalities: in claims 22 and 26, where applicants cite, "...20-40□...", should cite -- 20-40Å --. Appropriate correction is required.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1-6, 10-12 and 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Funai et al. (U.S. 6,162,667) in view of Hoga (U.S. 4,552,595).

Funai et al. (Figs.19A-D) in a related method to form a crystalline semiconductor film structure teach forming an amorphous silicon film (1302) over a substrate (1301, 1300); cleaning a surface of the silicon film (1302) by using HF aqueous solution;

preheating said silicon film (1302) to form an oxide film (1303); applying a first heat treatment to the silicon film (1302) having said oxide film (1303) formed thereon thus forming a crystallizing said silicon film; cleaning the surface of the crystallized silicon film; and applying second heat treatment consisting of a laser beam to said semiconductor film to improve the crystalinity of the semiconductor film (1302a), said laser beam in an inert atmosphere applied at an energy density of 200 to 400 mJ/cm^2 (column 44, line 41 – column 45, line 48). Furthermore, Funai et al. teach forming an oxide layer (1306) over the crystallized silicon film; implanting dopants through the oxide layer (1306) into the crystallized silicon film, wherein said implantation deteriorates the crystalinity of said silicon film; and performing a third heat treatment consisting of a laser beam (1312) in an inert atmosphere to said deteriorated silicon film through said oxide layer (1306) to activate implanted dopants and to improve the crystalinity of said deteriorated silicon film at an energy of 200 to 250 mJ/cm^2 (column 45, line 57 – column 46, line 49).

Funai et al. fail to teach applying the laser beam in a nitrogen atmosphere. However, Hoga (Figs.2A-2B) in a related method to form a crystalline semiconductor structure teach providing a silicon substrate (11); implanting ions into said substrate (11), thus forming an amorphous silicon layer (12); forming a second amorphous silicon layer (13); and performing a heating process by applying a laser in a nitrogen atmosphere to form a crystalline semiconductor film (14) (column 2, lines 53 – 61). It would have been obvious to combine the teachings of Funai et al. and Hoga to enable performing the heating processes of Funai et al. using the laser anneal process as

taught by Hoga, since this would result in the formation of a polycrystalline region in an inert atmosphere (column 2, lines 53 – 61) with reduced impurities. It would also have been obvious to one of ordinary skill in the art at the time the invention was made to enable performing all of the heating process disclosed in the combined teachings of Funai et al. and Hoga to arrive at the claimed invention.

Still, the combined teachings of Funai et al. and Hoga fail to teach wherein said laser beam has an energy density of 100 to 500 mJ/cm^2. However, in the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. MPEP 2144.05. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the laser energy range disclosed in the combined teachings of Funai et al. and Hoga to arrive at the claimed invention.

8. Claims 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Funai et al. (U.S. 6,162,667) in view of Yoneda (U.S. 5,648,282) and Hoga (U.S. 4,552,595).

Funai et al. (Figs.19A-D) in a related method to form a crystalline semiconductor film structure teach forming an amorphous silicon film (1302) over a substrate (1301, 1300); cleaning a surface of the silicon film (1302) by using HF aqueous solution; preheating said silicon film in an oxygen environment (1302) to form an oxide film (1303); applying a first heat treatment to the silicon film (1302) having said oxide film (1303) formed thereon thus forming a crystallizing said silicon film; cleaning the surface of the crystallized silicon film; and applying second heat treatment consisting of a laser

beam to said semiconductor film to improve the crystalinity of the semiconductor film (1302a), said laser beam in an inert atmosphere applied at an energy density of 200 to 400 mJ/cm^2 (column 44, line 41 – column 45, line 48). Furthermore, Funai et al. teach forming an oxide layer (1306) over the crystallized silicon film; implanting dopants through the oxide layer (1306) into the crystallized silicon film, wherein said implantation deteriorates the crystalinity of said silicon film; and performing a third heat treatment consisting of a laser beam (1312) in an inert atmosphere to said deteriorated silicon film through said oxide layer (1306) to activate implanted dopants and to improve the crystalinity of said deteriorated silicon film at an energy of 200 to 250 mJ/cm^2 (column 45, line 57 – column 46, line 49).

Funai et al. fail to teach preheating said semiconductor film in an atmosphere containing oxygen and nitrogen. However, Yoneda (Fig.1A) in a related method to form an oxide layer teaches heating a semiconductor substrate (101) in an atmosphere containing oxygen and nitrogen environment to form and oxide film over a region (110) in the semiconductor substrate (101) (column 11, line 53 – column 12, line 5). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to perform the heating process in an oxygen and nitrogen atmosphere as taught by Yoneda in the crystalline semiconductor film process of Funai et al., since this would result in the formation of an oxide layer in a purged environment (column 11, line 53 – column 12, line 5).

The combined teachings of Funai et al. and Hoga fail to teach applying the laser beam in a nitrogen atmosphere. However, Hoga (Figs.2A-2B) in a related method to

form a crystalline semiconductor structure teach providing a silicon substrate (11); implanting ions into said substrate (11), thus forming an amorphous silicon layer (12); forming a second amorphous silicon layer (13); and performing a heating process by applying a laser in a nitrogen atmosphere to form a crystalline semiconductor film (14) (column 2, lines 53 – 61). It would have been obvious to combine the teachings of Funai et al. and Yoneda with the teachings of Hoga to enable performing the heating processes of Funai et al. and Yoneda using the laser anneal process as taught by Hoga, since this would result in the formation of a polycrystalline region in an inert atmosphere (column 2, lines 53 – 61) with reduced impurities. It would also have been obvious to one of ordinary skill in the art at the time the invention was made to enable performing all of the heating process disclosed in the combined teachings of Funai et al., Yoneda and Hoga to arrive at the claimed invention.

Still, the combined teachings of Funai et al., Yoneda and Hoga fail to teach wherein said laser beam has an energy density of 100 to 500 mJ/cm^2. However, in the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. MPEP 2144.05. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the laser energy range disclosed in the combined teachings of Funai et al. and Hoga to arrive at the claimed invention.

9. Claims 19-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Funai et al. (U.S. 6,162,667) in view of Asai et al. (U.S. 5,365,875).

Funai et al. (Figs.19A-D) in a related method to form a crystalline semiconductor film structure teach forming an amorphous silicon film (1302) over a substrate (1301, 1300); cleaning a surface of the silicon film (1302) by using HF aqueous solution; preheating said silicon film (1302) to form an oxide film (1303), wherein the oxide film has a thickness of 20 Å; applying a first heat treatment to the silicon film (1302) having said oxide film (1303) formed thereon thus forming a crystallizing said silicon film; cleaning the surface of the crystallized silicon film; and applying second heat treatment consisting of a laser beam to said semiconductor film to improve the crystalinity of the semiconductor film (1302a), said laser beam applied at an energy density of 200 to 400 mJ/cm^2 (column 44, line 41 – column 45, line 48). Furthermore, Funai et al. teach forming an oxide layer (1306) over the crystallized silicon film; implanting dopants through the oxide layer (1306) into the crystallized silicon film, wherein said implantation deteriorates the crystalinity of said silicon film; and performing a third heat treatment consisting of a laser beam (1312) to said deteriorated silicon film through said oxide layer (1306) to activate implanted dopants and to improve the crystalinity of said deteriorated silicon film at an energy of 200 to 250 mJ/cm^2 (column 45, line 57 – column 46, line 49).

Funai et al. fail to teach applying the laser beam to form the crystalline semiconductor film in the air. However, Asai et al. (Figs.2a-2d) in a related method to form a crystalline semiconductor film teach applying a laser beam to a semiconductor layer 2, forming a crystalline semiconductor layer (2') in the air (column 10, line 20 – column 11, line 3). Therefore, it would have been obvious to one of ordinary skill in the

art at the time of the invention was made to form the crystalline semiconductor layer as taught by Asai et al. in the crystalline layer formation method of Funai et al., since this would result in an improved crystalinity of the semiconductor layer (column 10, lines 41 – 60).

Still, the combined teachings of Funai et al. and Asai et al. fail to teach wherein said laser beam has an energy density of 100 to 500 mJ/cm^2, and wherein said oxide layer has a thickness of 20-40Å. However, in the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. MPEP 2144.05. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the laser energy range and the oxide thickness disclosed in the combined teachings of Funai et al. and Hoga to arrive at the claimed invention.

Response to Arguments

10. Applicant's arguments filed 04/14/2003 have been fully considered but they are not persuasive.

Applicants argue, "...neither Funai, nor Hoga, nor the combination thereof, teach or suggest cleaning the surface of the semiconductor film and then crystallizing the semiconductor film by irradiating the laser beam. For these reasons, it is respectfully suggested that the rejection of these claims is incorrect and should be withdrawn...". In response to these arguments, Funai et al. teach a step of forming a native oxide, followed by washing the substrate having the native oxide with aqueous HF, removing said native oxide prior to a crystallizing step (column 44, lines 58-67). Furthermore, the

Merriam-Webster dictionary defines washing as "to cleanse by or as if by the action of liquid". Therefore, Funai et al. teach the above-mentioned step.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Julio J. Maldonado whose telephone number is (571) 272-1864. The examiner can normally be reached on Monday through Friday.

13. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (571) 272-1855. The fax number for this group is 703-872-9306 for before final submissions, 703-872-9306 for after final

submissions and the customer service number for group 2800 is (703) 306-3329.

Updates can be found at http://www.uspto.gov/web/info/2800.htm.

Julio J. Maldonado
Patent Examiner
Art Unit 2823

Julio J. Maldonado
August 23, 2004

George Fourson
Primary Examiner